IMPORTANCE OF VARIETY CHOICE IN SUNFLOWER'S ANSWER TO DIFFERENT LEVELS OF CROPPING INTENSIFICATION*

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Summary

Modern crop production technologies developed in response to concerns about environmental impacts of agriculture; such technologies generally addressed themselves towards cropping intensification reduction. In such a context, cultivar or hybrid choice is an important decision because cultivar response can deeply improve or worsen grain yield and quality.
By this way, it could be possible to achieve the full expression of genetic potential, or, on the contrary, to obtain the optimisation of used inputs.
In order to investigate this specific topic, a research was carried out, from 1995 to 1998, at Cesa, Arezzo (North-East Tuscany, Central-West Italy) by comparing various sunflower varieties (15 in each year) to evaluate their response to two different inputs levels: higher, called Conventional System, referred to usually adopted techniques and lower named 2078 System, based on the regional production disciplinary measures granting Reg. EU 2078/92.
Obtained results put on evidence principally a wide variability observed both among years and among varieties that is an evidence of the absence of a clear and unambiguous effect due to experimental treatments which almost never achieved statistical relevance.
Variety choice does not seem able to noticeably influence the response of sunflower to cropping intensification proving that, at least in experimental conditions, varieties cannot appreciably help to make more efficient sunflower-based low-input systems.

Introduction

Modern crop production technologies developed in response to concerns about environmental impacts of agriculture; such technologies generally addressed themselves towards cropping intensification reduction. In such a context, cultivar or hybrid choice is an important decision because cultivar response can deeply improve or worsen grain yield and quality.
Nevertheless, most authors focused their work on low-input cropping systems or on the varietal response to environmental conditions whereas only few works coupled varieties and input levels. Indeed, a careful choice of the most suitable variety, for characteristics of precocity and/or resistance to biotic and abiotic limiting factors but, more important, for features of hardness and ability to sustain limiting conditions, could allow to gain satisfactory yields and good economical results, especially when adopting a low level of cropping intensification (see reg. EU 2078/92). By this way, it could be possible to achieve the full expression of genetic potential, or, on the contrary, to obtain the optimisation of used inputs.
Besides, as sunflower is not very responsive to larger amounts of inputs (Bonari *et al*., 1996), the variety choice to adopt could be not so important as for other crops.
In order to investigate this specific topic, a research was carried out, from 1995 to1998, at Cesa (lat. 43° 18’ 07” North long. 11° 49’ 15” East, 244 m on sea level), Arezzo (North-East Tuscany, Central-West Italy) by comparing various sunflower varieties (15 in each year) in their response to two different input levels. The research was part of a larger experimental design carried out to evaluate the possibility of reducing chemical and mechanical inputs in farm’s productive systems and/or to verify real agronomic, economic and environmental correspondence of cropping techniques recommended by the measure A1 of Reg. 2078/92 (Bonari *et al*., 2000).

Methods

The field experimentation started in 1995 in one of the widest and most interesting plain of the region and compared a technical management called Conventional (Conv-Syst) which refers to usual regional practices and a reduced management (2078-Syst) based on input limitations governed by a regional application of Reg. 2078/92. Both systems followed the same crop rotation (sunflower- durum wheat - maize- winter wheat) but differed by soil tillage, fertilization levels and of herbicide strategies.
Conventional techniques were composed of medium deep tillage, fertilization of 120 kg/ha of N, 90 kg/ha of P_2O_5, application of soil disinfectants and herbicides (pre-emergence), while low-input techniques used more superficial and reduced tillage, lower fertilizations (90 kg/ha of N, 70 kg/ha of P_2O_5), no soil disinfectant and herbicides in post-emergence.
Technical operations for sunflower cropping are summarized in Table 1.
The soil of the experiment (Tab. 2) is a clay-loam; it has a sufficient percentage of organic matter, phosphorus and potash, a high cation exchange capacity (CSC), but a low total nitrogen content.
The climate of the area is Mediterranean with annual precipitation exceeding 700 mm, most of which being concentrated in autumn and, in a sligthtly way, in spring. Monthly average of maximum temperature is 30 °C, while the average of minimum temperatures can go below zero in the first months of the year (Bonari *et al.*, 1999).

Table 1. Cropping techniques for the two cropping systems.

Techniques	**Conv-Syst**	**2078-Syst**
Tillage	ploughing (40-45 cm)	subsoiling (40 cm)
Fertilization	N 94+26†	N 64+26†
(kg/ha)	P_2O_5 44+46†	P_2O_5 70†
Soil disinfectant	furatiocarb	no
Weed chemical control:		
pre-emergence	oxifluorfen	
post-emergence		pendimetalin+linuron

† at sowing and top dressing

Table 2. Soil physical and chemical characteristics

Characteristic	**Unit**	
Sand	%	39.23
Silt	%	26.01
Clay	%	34.75
Organic matter†	%	1.51
Total N ‡	g/kg	0.78
Assimilable P ¶	mg/kg	28.85
Exchangeable K §	mg/kg	136.55
Ca CO_3	%	0.14
CSC	meq/100g	28.87

† Walkley Black method; ‡ Kjeldhal method; ¶ Olsen method; § Method with $BaCl_2$.

Results

We focused our attention on yield results and oil production per hectare for each variety. All the results were gathered on Fig.1 and 2.

The analysis of yield clearly shows that there is some variability in the response of varieties: in 21 cases out of 60 (35%), the yield response was not influenced by input level (that is, the relative points were inside the area of isoproduction), while in most cases (45% that is 27/60) we point out lower yields when varieties were managed with input reduction (2078-Syst), so that the relative points stand below the line of –10% of isoproduction.

Finally, only in 12 cases (20%) we found a positive response of varieties to input reduction, testified by points upon the line of +10% of isoproduction.

Oil production per hectare is obtained by multiplying dry achene yield/ha by for corresponding oil percentage. Results were not so different than the previous ones: 28% of the cases resulted in isoproduction, while 47% of varieties managed under less intensive farming methods showed lower yields and, finally only 15% of the cases expressed a higher productivity with 2078-Syst

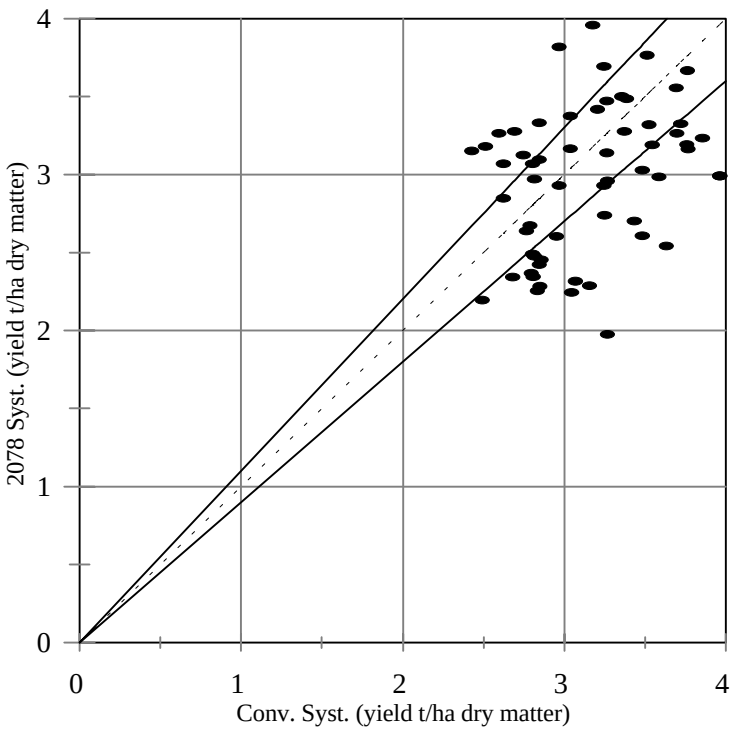

Figure 1. Sunflower variety yields (t/ha of dry matter).
Dashed line represents the isoproduction line between Conv-Syst and 2078-Syst, whereas continuous lines define a variation area of ± 10% of the isoproduction

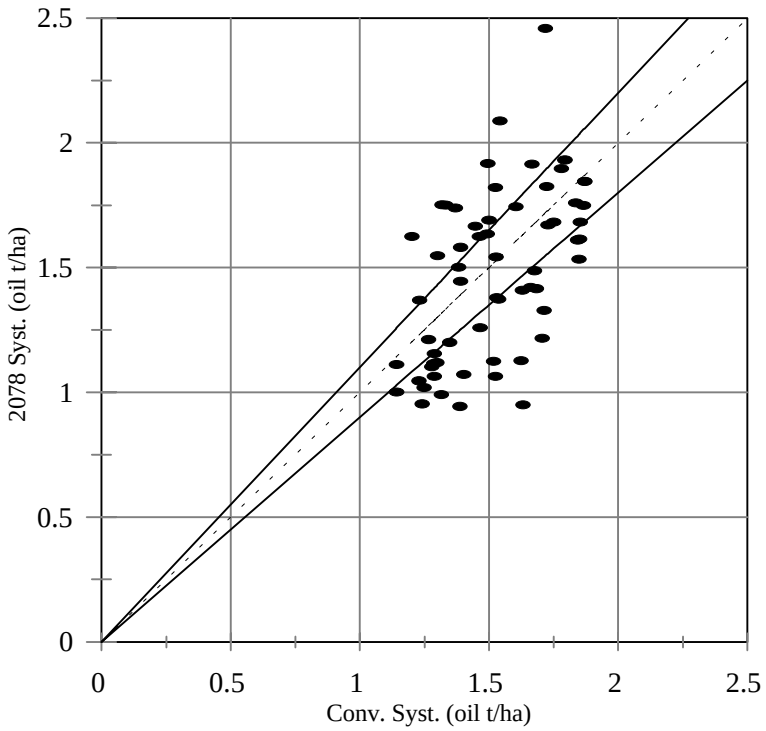

Figure 2. Sunflower oil production for a range of varieties (t/ha).
Dashed line represents the isoproduction line between Conv-Syst and 2078-Syst, whereas continuous lines define a variation area of ± 10% of the isoproduction

In Table 3 only significant data pointed out by statistical analysis are reported; obviously, only few varieties responded significantly to the variation of intensification level.
Only in the first two years (1995 and 1996), some varieties positively answered to larger input availability; in 1995, four varieties yielded more achenes, and only one of these varieties (Odil) also produced more oil when Conv-Syst was adopted (+25%). In 1996, three varieties had significant differences between the two management systems, but only for Odil and Olbaril, this increase was associated to a higher oil production per hectare.
On the contrary, in 1997, when climatic and agronomic conditions were more favourable (both for rain amount and distribution), no clear response was observed which suggests that the effect of cropping intensification level strongly depends on the presence of limiting conditions.
In 1998, Gloriasol showed a positive response to low input techniques with a yield increase of 20% of dry achenes (+0.78 t/ha) and +26% of oil (+0.53 t/ha), although this behaviour was no experimentally confirmed in the other years of research.

Table 3. Statistical analysis of yields (t/ha dry achenes) and oil production (t/ha).

Yield (t/ha dry achenes)					
Year	Variety	2078-Syst	Conv-Syst	F	p
1995	MONTENUOVO	2.37	2.80	35.58	0.03
1995	ODIL	2.44	3.05	384.64	0.00
1995	PARDISOL	2.42	2.85	3.07	0.02
1995	VIDEO	2.25	2.84	36.7	0.03
1996	FLOROM 350	3.27	3.70	51.58	0.02
1996	ODIL	2.54	3.63	75.81	0.01
1996	OLBARIL	1.98	3.27	97.52	0.01
1998	GLORIASOL	3.96	3.18	23.32	0.04
Oil production (t/ha)					
Year	Variety	2078-Syst	Conv-Syst	F	p
1995	ODIL	0.99	1.32	30.95	0.03
1996	ODIL	1.13	1.63	22.74	0.04
1996	OLBARIL	0.95	1.63	200.31	0.01
1998	GLORIASOL	2.07	1.54	17.49	0.05

Conclusions

Results generally show that a larger input availability sporadically caused a positive effect on achieved yields and even in one case caused a reduction of yield.
Anyway, the wide variability observed both among years and among varieties is an evidence of the absence of a clear and unambiguous effect due to experimental treatments which almost never achieved statistical relevance.
Nevertheless, some varietal responses should be mentioned: only Gloriasol yielded significantly more in the 2078 system in 1998, even if higher yields have been registered in 2078-Syst in three of the four of the studied years; Dogo and Euroflor, in a less relevant way than the previous variety, were more productive if managed under a lower level of inputs (about +0.2 t/ha).
On the contrary, Odil, and Florom 350 always preferred a conventional management (respectively +0.3 t/ha and +0.6t/ha as 4-year period's average) but most of the varieties were indifferent to input availability or reacted differently in the various years.

So, at least in experimental conditions and for a limited range of varieties, the decision upon variety cannot appreciably help to make more efficient sunflower-based cropping systems.

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